Virtualness

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9 Comparative case study analysis

9.1 Introduction

In this chapter, the three case studies are compared on the dimensions mentioned earlier. These dimensions are within the degree of virtualness, the contextual aspects related to virtualness, knowledge transfer and development and virtualness related to knowledge. These dimensions are compared and analysed for the three case studies.

9.2 Degree of virtualness

The three case studies had different degrees of virtualness. Virtualness was defined as the amount of geographical dispersion of the workforce and the use of IT for communication and co-ordination. In figure 9.1 the three case studies are visualised on a scale of use of IT and dispersion of the workforce.

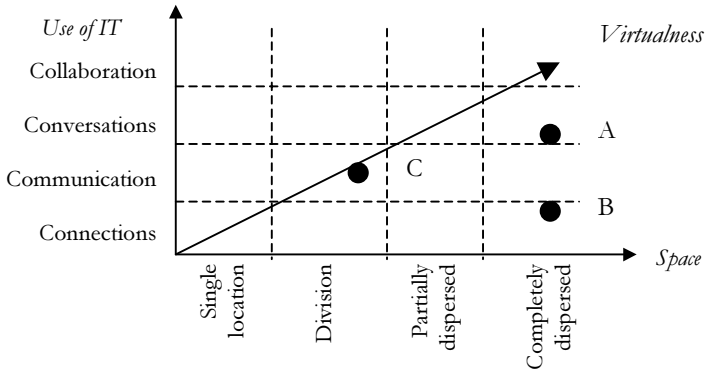

Figure 9.1: Degree of virtualness for all three case studies.

Case study A had a complete geographical dispersion of the workforce; its involvees were spread throughout Sweden, Germany, Belgium, France, the Netherlands and the USA. The involvees consist of the core members who performed the work, but also the involved mother organisations that sponsored the research. Case A used several types of IT for distributing information and for enabling communication (e-mail, chat, ICQ[1], a file-sharing system (BSCW) and tests of a virtual coffee room and video conferencing). However, the use of IT was mainly within the core group of members, and not spread towards the mother organisations (although they had access to it). Case B was completely dispersed with members mainly located throughout Sweden (although several had a different land of birth). The project leader came from the Netherlands and the main language was English. Furthermore, there was hardly any use of IT for communication. Only e-mail was used for distributing minutes of the meeting and reports. Case study C was a large project organisation and had a main office and two regional offices on site. Furthermore, some members of the regional offices were located for several days at the construction sites (but these members had an office space within their regional office where they could meet, therefore the focus is more on a divisionalised structure). IT was mainly used for distributing, storing and retrieving information, but IT was less used for communication. The intranet of case C was used

[1] I seek you, programme for communicating on-line, comparable with chat.

extensively for job descriptions, procedures, quality control, process descriptions and approved progress reports of the work (no draft or working versions were available). However, IT was hardly used to enable communication between members. Furthermore, the intranet was only reachable from within the project organisation (building). Therefore, the use of IT is defined as moderate in this respect. Below the three case studies are compared in table 9.1.

Degree of virtualness	Case A	Case B	Case C
Space	Complete dispersion (++++)	Complete dispersion (++++)	Divisionalised (partially dispersed) (++)
Use of IT	Satisfying use of IT. Conversation (+++)	No use of IT (only e-mail) (+)	Moderate use of IT (availability is low) (++)
Virtualness	(+++++++) 7	(+++++) 5	(++++) 4

Table 9.1: Degree of virtualness of three case studies. (Maximum amount of virtualness can be 8).

Concluding one could state that case study A has a rather high level of virtualness, case B has a moderate degree of virtualness and case study C has a low degree of virtualness.

9.3 Contextual aspects of virtualness

From literature and from the empirical studies it becomes clear that a number of aspects indicate and affect virtualness. These aspects have been discussed within chapters 6, 7 and 8 as contextual aspects. These aspects were partially defined with help of the theoretical reference frame and from empirical data. Within the three cases, several contextual aspects were of importance, while others could not be used for indicating virtualness. Some of the contextual aspects can be perceived in other organisation structures as well. However, they are discussed in this respect since they were of importance to the case studies under investigation.

9.3.1 Co-ordination and structure

The co-ordination and structure of the project organisation were of importance within the theoretical reference framework. Within the empirical studies the co-ordination and structure of the project organisations differed. From all three case studies a communication scheme was presented in which was made clear which members of the internal project organisation (core group) communicated often with other members. Case study A initially did not have a hierarchy or structure within the project organisation. However, based on the communication scheme and the observations and interviews, a certain hierarchy of communication arose over time. These participants gained more decision-making power in order to decide on the content of the research of the project organisation. Several roles were indicated in chapter 6. The management roles were within a broker role, which was responsible for the contact between the internal project organisation members and the mother companies. The architect role consisted of a group of supervisors and some PhD members who decided upon the way to proceed with the research. Case study A was a research project in which the final goal was not clearly described. Furthermore, tasks, roles and responsibilities of involvees were defined over time. The expectation of the project organisation was that a high interdependency between the subprojects or between the participants of the core group was present. However, over time it became clear that most work was rather individually and there was hardly any task interdependency. The arising management

group tried to integrate the individual research into a book with research results that was presented to the mother organisations.

Co-ordination	Case A	Case B	Case C
Task	Non-routine research Explorative Little interdependency (task based upon individual research for a PhD title).	Applying research results to new situations (exploitation) No interdependency Project leader integrated the work.	Applying experience and theory to a new situation. Development of new methods and measurements. Rather much interdependency between tasks. Later on more routine tasks.
Structure	Loose and flexible project structure. Hierarchy arises over time (broker and architect roles)	Loose and flexible project structure. Clear responsibilities, tasks and roles. Two project leaders in charge.	Clear project organisation structure, structure is adjusted to the new situation per project phase. Formal hierarchy available. Clear descriptions of roles and responsibilities.
Content (primary process)	Mutual adjustment in the beginning. All parties were equal to decide upon the progress. Later on a group of people arose who made decisions about the content.	Mutual adjustment but steered by the project management towards a certain direction.	Not investigated here.
Control	Direct supervision of the CEO. The supervisors of the subprojects were in charge of the results within the subprojects.	Direct supervision of the project manager	Initially for the development of the organisation, mutual adjustment. Later on clear hierarchy available with much responsibility for the regional offices.
Contact mother organi-sation	Contact only with the broker (project leader). Contact based upon previous experience, social network.	The whole group had good contact with the steering committee. The CEO (broker) and project manager (architect) had contact with the mother organisations	Mainly contact with mother organisations trough higher management. Some personal relationships present.

Table 9.2: Comparing co-ordination and co-ordination mechanisms for three case studies.

Case study B was structured differently from the beginning. A clear project manger role (broker) and a clear architect role (project leader for the content) were defined and these persons steered the project organisation. Case study B was a project organisation with hardly any interdependency between the member's tasks; the project organisation had a clear goal. Furthermore, the work performed was based on previous experience and existing research was applied to a new situation (hardly innovative). Furthermore, a clear description was presented about the role, tasks and responsibilities of the involved parties.

Case C was a rather different project organisation than case A and B. Case C was a very large project organisation with a clear product as its main goal. The case was only investigated from the project control organisation behind the whole construction project. Within the project control organisation there were a clear hierarchy, roles, responsibilities, and tasks available in order to steer the construction work within the planned time, budget and quality. Furthermore, within the project control organisation there was a certain amount of task interdependency in which members of the higher levels of the project organisation were dependent on the work of the lower levels in the project organisation. This task interdependency implied that periodical meetings were needed in order to discuss and transfer information within the project control organisation. There was innovation in the primary process. However, for the project control organisation, the level of innovation was much lower. The initialisation phase of the project control organisation required a certain amount of exploration of the members in order to develop methods and measurements of control. However, exploration in this respect is to apply experience and existing theory to new situations. In later phases of the project organisation, the control tasks became more consolidating and routine and required fewer interactions for development. Table 9.2 presents a summary of co-ordination and structure of all three case studies.

9.3.2 Time

Time was an aspect that did not play an important role for indicating virtualness; however, time was important for working together and for transferring knowledge within a project organisation with a degree of virtualness. Case A and B were short-term project organisations of three respectively one year. Within case A, attention was paid to social gatherings, team-building sessions and diners with the group in order to get acquainted. Participants stated that these social aspects should be increased for close co-operation. Case B only had social dinners after formal meetings and there was little social interaction between its members. The members of case B did not get to know each other well and had no reputation of working together before or in the near future. Within case B, members only worked to fulfil their own task, there was no interdependency and hardly any contact in between the meetings. The time of case B was too short to get acquainted and to learn to trust each other for transferring knowledge. Case C on the other hand was a project organisation that lasted 10 years. Although there was a heavy fluctuation of the workforce, there were a number of aspects developed over time that could increase social interactions. Furthermore, information distribution and communication with organisational members was made more effective through the development and implementation of procedures, quality controls, process descriptions, address books, interviews with members and a progress journal of the construction work. Concluding one could state that the duration of a co-operative project organisation is of influence to knowledge transfer. A longer duration has a more positive effect on knowledge transfer compared to a very short project organisation.

9.3.3 Involvees

In all three case studies, involvees came from different groups. In all case studies there was an internal core group who performed the actual work. This internal group often had a back-office or was self-employed and was seconded to the project organisation for a certain period of time. The fact that most participants of the internal core had a mother organisation different than the project organisation could cause priority and loyalty problems. This was mentioned by one of the project leaders of case study A. Besides the internal core group, there were linkages to industrial organisations that

financed (sponsored) or even managed the project organisations to a certain extent. These organisations are defined as the mother companies. Furthermore, in case A and B the members had interdisciplinary expertise and came from different countries (had different native languages), while the common language of the project organisation was English. Case C was a Dutch project organisation, in which interdisciplinary fields were available, but these fields were more divided into functional departments (people within the control department had a rather similar background within control and financial expertise).

In case A several gaps were found between two parties. (1) A gap between academia and industry. The internal core of case A consisted of researchers of universities who performed research for their PhD dissertation. The mother companies (clients) of the project organisation were industrial partners in the electricity industry. There was a clear gap in perspective (problems and content), time perspective (industry had a short-term perspective, while research a long-term perspective), benefits and results (industrial results should be in clear ideas for future products, research results were more in articles and dissertations). Due to geographical dispersion and little interaction between the core and the mother organisations, the gap between the two groups was not resolved. The management of the project organisation tried to compensate by presenting the research results in a consulting manner to the industrial partners. (2) The second gap was between technical and social scientists within the internal core of the project organisation. Both groups had different theoretical backgrounds, methodologies and even different research paradigms that they applied. These differences made it difficult to discuss research results and consequently it had impact on knowledge transfer and collective knowledge development.

Involvees	Case A	Case B	Case C
Involved parties	Internal core with back-offices (universities and consultants) Mother organisations (mainly private)	Internal core (universities and consultants) Steering committee Mother organisations (public-private)	Internal core (self-employed, consultants) Mother organisations (public and private partner).
Gaps perceived	Gap industry-academia: methods, benefits, results, time perspective Gap technical – social science: methodology, paradigm, results	No gap perceived	Gap between public - private way of doing business: decision-making policy, control aspects.
Fluctuation	50% of workforce (either left or was finished with their task)	None	50% of workforce (either left, received other assignments or finished their task)

Table 9.3: Comparison on involvees of three case studies.

For case A, the final results of the project organisation and benefits to all were not clear to all stakeholders. However, within the project organisation it became important to understand the use and benefit of the work towards all parties, in order to increase satisfaction within the co-operation. The stakeholders of case study A had rather diverse interests, goals and benefits for participating within the research. However, these diversities in interest were hardly made explicit. Therefore, it is of importance what kind of knowledge the project organisation wants to receive from the autonomous

partners involved and what kind of activity of the partner is expected. Therefore, selection of partners is interesting to look upon. One project leader described how partners of such a project organisation could be selected.

> "One has to be rather explicit in what the rewards are and what not. Furthermore, you should tell them that they could learn of the process, if they are not interested in this, then one should look for other partners and one should look for the right people. … One should think about the value of matters, for who is this value important and presentations should be adjusted to this" (Case A: PL1).

In case B no clear gaps were perceived. Members of case B had a rather good interaction with the steering committee members, whom they met five times during the project organisation duration. However, they did not have contact with the mother organisations that sponsored the project organisation. Only the CEO presented results to the clients. Case B did not have the intention to use expertise of the mother companies; they only sponsored the project organisation financially. The mother organisations were the clients of case B and were mainly interested in the final result.

In case C a gap was perceived between the industrial (private) way of doing business as was common in construction work and the more public (governmental) way of making decisions (bureaucracy). The mother companies of case C were both a private and a public company and their responsibilities, financial support and expert support were rather clear. Several members mentioned that they had experience in working for more private organisations, in which time, budget, and quality were of importance for the construction work. However, they experienced a decision-making policy that was more bureaucratic than they were used to. This policy was more based on controlling the work performed with help of a formal hierarchy and quarterly reports to the government (Table 9.3 presents an overview of the three case studies in the subject of involvees).

9.3.4 Expectations

From the empirical data of case A, it was found that expectations of members were of importance to the satisfaction and well being of the internal core members within the case study. This implied that expectations became interesting to look upon in the other case studies as well. From the data codification process several kinds of expectations were found in all three case studies (they are defined as expectation fields). These fields were within content (the task that should be performed), role, process (the development of the project organisation), information distribution (case A) and communication (case A and C), expectations on the mother organisations (sponsors) and the expectations of the project organisation itself (the management team). Besides denoting that there were several fields in which participants could have explicit expectations for their work within the project organisation, several expectation conflicts were found. These conflicts were found when a mismatch in initial expectations was found. Due to a mismatch the expectation was either altered, or dissatisfaction about this particular aspect arose. Most mismatches and expectation conflicts were found in case A. Here mismatches of (a) individual expectations of personal goals were found; (b) mismatches between other expectations and one's own expectations and (c) mismatches between the project organisation and the individual member. The last mismatch was rather serious in the fact that either the project organisation finished the contract with the participant, or the participant left the project organisation since the mismatch could not be resolved. Case B presented hardly any serious expectation mismatches. The only mismatches were found within individual and other's expectations. Case study C had three types of conflicts within expectations. These

mismatches were (a) individual expectation mismatches, (b) expectation mismatches between participants about tasks and roles (what is expected by others and from others), (c) mismatches between central and regional units and between the project organisation and its clients (mother organisations).

Less expectation conflicts were found in case B and C, this was mainly due to the fact that expectations were made explicit once members were attracted to the project organisation. Within case B expectations of participants were discussed on the first and last project meeting. Case C discussed expectations together with application procedures. There are several reasons why less expectation mismatches were found in case C.

1. When members were hired, especially members on higher management positions, there was a discussion about mutual expectations between the project organisation and the new participant. Furthermore, clear functional descriptions were available for members on lower levels within the project organisation. Members knew what was expected of them and what kind of task they had;
2. Another aspect was that most members could steer their own role and tasks rather well into areas they appreciated. There was a high level of autonomy and members mentioned that they were able to steer their work according to their own expectations;
3. Members were not very committed towards the project organisation and it was not difficult to leave the project organisation. There was a high amount of people leaving the project organisation (around 50% per year). This was also perceived as a legitimate way of acting. A large amount of the participants mentioned that members in general stayed for 1 to 1,5 years. Those people who were with the project organisation for more that four years called themselves (and were called) senior members, since they had been part of the development process of the project organisation. Some members already mentioned that they did not want to work longer in the project organisation than 1,5 years, and when another challenging opportunity would come along they would take this. For these reasons, the threshold for leaving the project organisation was not very high. The reasons for leaving could be part of expectation conflicts, but also several other aspects played a role (e.g., new opportunities, a specific part was developed and the challenge became a routine job).

Table 9.4 presents an overview of the three case studies on the subject of individual expectations.

Some conclusions that can be made from the empirical studies are the following:

- More diverse expectations are found in a research project organisation in which no fixed goal is presented and the tasks and functions are unclear (case A), compared to a rather structured project organisation, with clearly defined roles, functions and goals (case B and C);
- Making mutual expectations (of the participant and the project organisation) explicit when hiring people, decreases mismatches in expectations;
- Experience is of influence to the expectations of people and fewer mismatches could be found with members who had experience in working in project organisations. This was especially seen in case C. Members with experience had low (or sometimes negative) expectations;
- Those people who had a serious expectation conflict between the project organisation's expectations and their own expectations left the project

organisation, or their contract was not prolonged (as was the case in project organisation A and partially in case C);

	Case A	Case B	Case C
Expec-tation conflicts	• Personal • Other's expectation • Organisation - individual	• Personal • Other's expectation	• Personal • Other's expectations • Central – regional units • Project- clients
Amount	• Matches: 20 • Mismatches: 41	• Matches: 27 • Mismatches: 15	• Matches: 13 • Mismatches: 20
Reasons	• No explicit expectations • No clear roles, tasks and responsibilities • No clear organisational expectations. • Unclear what role the sponsors had.	• Expectations made explicit initially and evaluated afterwards	• Expectations made explicit. • Much freedom to steer the work. • Legitimate reasons for leaving the project. • People have experience in working in these kinds of projects
Symp-toms	Frustration, less commitment, leaving the organisation.	Some frustrations	Frustrations, conflicts between groups of members. Members leaving the organisation (but also based on other reasons)

Table 9.4: Comparison of expectation conflicts of three case studies.

- Commitment towards the project organisation plays an important role in expectations and expectation mismatches. With low commitment, expectations are mainly individual and the slightest things can make the participant leave the project organisation. With a high commitment, people deal differently with expectation conflicts, since they do not want to leave the project organisation, even though their expectations did not always come true. Some members adjusted their own work towards their expectations, while others adjusted their expectations. In case A there was a core group of members who had expectation conflicts, but they felt committed to the project organisation and adjusted their expectations to the new situation (also in case C there was a very small group who felt more committed to the project organisation, they were considered to be senior members);
- Commitment could be related to the task performed. If the task is to write a PhD dissertation, the task becomes very personal. However, when the task is to use one's expertise within a certain period of time in the form of consultancy, the commitment towards the project organisation is less high. One only tries to perform one's task to their best capabilities, and then leaves when the task is finished;
- The time factor of the individual projects of experts is of importance. According to one of the project leaders:
  "The time factor of each person in the project is different, this is probably important for expectation management and causes different points of view on the organisation" (Case A: PL8).

In all cases, expectations of individual members can be related to trust. The trust that was found can be perceived as trust from a psychological contract between employee and employer.

9.3.5 Communication and information distribution

Communication and information distribution are important aspects when discussing virtualness. From literature, organisations with a high level of virtualness are rather dependent on using IT for communication and distributing information. However, from the three case studies it became clear that members within all three cases mainly communicated via e-mail and face-to-face. Case A, had the highest degree of virtualness, and offered a number of IT tools that could support communication and information distribution. However, from a questionnaire it was found that most people used face-to-face contact and e-mail for communication. Several members stated that they were interested in using more IT for their work, but there were a number of aspects found why IT was not used to its full capacities. (a) There was no culture or norm for distributing information to each other. It was unclear how often reports should be sent, what should be in these reports and to whom they should be sent. (b) The system used in case A required an active role of the participant for updating material and structuring documents for others. Most members did not have the proper training for working with such a system and their workload was too high to experiment with the system in order to learn its functions. (c) Several members were unwilling to put their articles and working material on an intranet site. They were afraid of disclosure of information (distrust in other involvees). (d) There had been several technical problems with the system, and the threshold became higher for members with less IT experience. There was little trust in using the system. (e) The project organisation did not give incentives or punishments to work with the system. (f) Members had no previous affiliation and little trust was present in the beginning. (g) The project organisation was multi-disciplinary, members worked mainly individually in their own expertise field. The project meetings discussed the system, future systems and the use of IT to a large extent, and several members were disappointed that not all participants were actively involved.

> "I had expected that all members would influence the development of an information system for the whole case A. But there was no interest and nothing to complain or comment upon. Several persons used the file server system, but we did not find the right meaning with it. Neither did we found the need. Maybe we did not need the file-sharing system in the first place, but we could have managed with an updated web page" (Case A: PM2).

In case B, the management had learned from case study A and they decided that they did not want to use an IT system that enabled communication and distribution of information. In case B the only use of IT was with e-mail. Reports and minutes of meetings were sent with e-mail to the participants. There were five meetings in total with the internal core and the steering committee and most communication was face-to-face communication. Between the members of the internal core, there was hardly any communication in between the meetings. Case B did not intent to cooperate and develop trust. However, both in case A and B the social events and contacts were appreciated and members would like to have more informal contact.

- "We always agreed that meetings, team-building meetings or social meetings, were very good and we needed more of this. It felt that we should do this more, but then again we were trying to do this virtually. Actually asking management of having more of such

things would have meant giving up the idea of a virtual organisation to a large extent" (Case A: PM1).

- "I hoped to have more contact with the others, we have had little contact only within the meetings, and this was too little. All members are within their little corner and one only meets in order to summarise what one has done" (Case B: PM21).

	Case A	Case B	Case C
Main communi-cation means	• Face-to-face (in meetings) • E-mail • File sharing system	• Face-to-face (in meetings) • E-mail	• Face-to-face • Telephone • E-mail • Meetings/ bilateral meetings
Use of IT	File sharing system, chat, internet site, and e-mail.	E-mail	E-mail, intranet site for information distribution.
Effect of virtualness	Some social and informal meetings (1-2 a year). Time scheduled for team-building and internal communication.	No informal meetings, no attention paid to social contact.	Rather good contact between members with proximity. Less good contact over geographical space.

Table 9.5: Comparison of communication between the three case studies (including information distribution).

Case study C had a different project organisation structure than case A and B. Furthermore; its workforce was divisionalised (and to a small extent partially dispersed). The fact that members are located on locations and can meet each other regularly makes it easier to distribute information and communicate informally. From the interviews it became clear that a large amount of contact between participants was face-to-face and via the telephone. The intranet available was not used for communication, but mainly for storing, retrieving and distributing information. Participants of case C had the possibility to meet each other personally. The regional teams were located together and the head office had a large location where people could meet. However, it became more difficult to cross the distance between the two regional offices and the regional and head office.

> "I am located very close to the regional office. In principal you can drop in on everybody. The formal side has once per three months a formal meeting. The informal side and ad hoc discussions are possible when things are not clear and we inform each other. Then it is very nice that the distance is so small and we are located close together" (Case C: PM26).

Table 9.5 summarises the data of the three case studies. Concluding one could state that geographical dispersion plays a role for communication. Especially informal communication and social interaction between members is affected by the fact that members are not located on the same place. Furthermore, in case A, the project management tried to overcome the lack of social interaction by implementing team-building sessions in which people could get acquainted.

9.4 Knowledge development and transfer

The initial assumption of the research (see chapter one) was that for a project organisation with a high degree of virtualness little tacit knowledge is transferred within the project organisation. However, it was found from the empirical research that tacit knowledge could be transferred, but this transfer was not within the project organisation itself, but more towards the involved parties. The three case studies had

several aspects that were of importance for learning and transfer of knowledge. (a) A fluctuating workforce of which members were only hired to fulfil a certain task. (b) In case A and B there was little task interdependency, in case C there was moderate task interdependency. (c) The project organisation disbands once the target has been fulfilled. It was unclear what would happen to the knowledge developed within the project organisation. (d) The dispersion of members to a certain extent (different per case study) and (e) the duration of the project organisation. In case A and B a short duration was present, while case C had 10 years of duration.

In all cases it was stated that participants learned rather much from their individual work in the project organisation, they learned more about their own field (especially in the case studies A and B), they learned to work in such an organisation structure and they learned project management (in case C). However, when discussing knowledge transfer within the whole project organisation, many participants mentioned that not much organisational knowledge was transferred. Organisational knowledge can be found within the culture, language, jargon, procedure and norms of a project organisation.

The initiating organisation behind case study A and B, mentioned in interviews that they had learned rather much from following the project organisations and they had re-used this knowledge when they started up new geographical dispersed project organisations. Furthermore, in case C, management mentioned that other similar project organisations could learn from the knowledge developed within their project organisation and they started on implementing a knowledge transfer mechanism between case C and another rather similar project organisation. These examples are only some of the aspects found within the case studies. From the empirical studies, it became clear that organisational learning in the form of routines, common language and culture was not developed in short term project organisations (like case A and B). However, other forms of knowledge transfer were found, that are not always taken into account in current learning literature. These types of knowledge transfer are mentioned below and visualised in table 9.6 (the knowledge field that was transferred is stated, not the content of the knowledge that was transferred). Five different levels of knowledge transfer were empirically found within the three case studies, (a) individual learning; (b) organisational knowledge transfer; (c) interorganisational knowledge transfer; (d) interpartner knowledge transfer and (e) interproject knowledge transfer. These five levels are discussed below.

1. Individual learning

In all three cases, experts were hired in order to fulfil a certain task. These experts worked rather individually, however, they did have to co-operate (to a certain extent) with other experts in the project organisation in order to fulfil the final goal. From all three case studies it became clear that individual members learned rather much. All case studies hired experts to either perform research within their field (case A) or to apply their expertise within a new situation (case B and C).

> "You pass through a whole process. We started with the realisation phase, so you learn different ups and downs and problem fields. Before I came here, I had seen construction specifications; however, I did not know on what aspects I had to pay attention. When I read the specifications now, I know exactly what is important for my expertise; planning, control but also quality" (case C: PM27).

In case A, members deepened their knowledge in their own field, while in case B and C, experience for applying knowledge in new situations was build up. Besides learning

within their own expertise field, members also learned about working in a project organisation structure with a degree of virtualness and its environment (industry or political environment). Furthermore, social networks of people participating in the project organisations were built up. In case A and B, members had little interdependency between their tasks and they could work rather individually. In case C the interdependency of the tasks was higher and members from the higher management levels of the control organisation were dependent on the work performed in the lower levels. The work in case A was explorative and new ideas had to be developed. Case B and C were more exploitative; they applied experience and existing theory to new situations. For example in case C, members had to develop new models and methods that corresponded to the situation of their project organisation. This development process was performed partially individual and partially with the whole control group. However the development of new methods mainly took place in the start-up phase of the project organisation. Later on the work became more routine.

2. Organisational knowledge transfer

Organisational knowledge transfer deals with knowledge that has been transferred or learned throughout the whole project organisation or within a certain part of the project organisation (for example the project control organisation). Examples of organisational knowledge transfer within the case studies are the development of a common jargon (partially in case A) and the development of a quality system (in case C) that was accepted and used throughout the whole project organisation. In case A, it was denoted that members had little communication besides the meetings (once a year) and there were language differences between participants from different countries and within several disciplines. In order to overcome these communication problems, team-building sessions were held in which concepts for communication and information-processing styles of members were presented and applied. These concepts (a communication jargon) helped to communicate between members with different backgrounds and over geographical space. These concepts were accepted to a certain extent within the core group. The concepts were used in meetings, social events and even in e-mail and chat communication for explaining situations and for adding humour to the project organisation. In case C, the project organisation developed an internal quality system that was applied and accepted by all members of the project organisation. All members, independently of where they were located, knew in this respect their task and role within the project organisation. Furthermore, the quality system tried to guarantee a decision-making process that was accepted by all parties. In case C, procedures for information distribution, meetings and routines were developed that were learned to all new members joining the project organisation. Case B did not develop any routines, procedures or common jargon. The project organisation only lasted one year, and there was too little time to learn organisationally.

Other aspects that were found with at least two case studies were the gaps between academic and industry and the gap between public and private companies.

- "There was a gap between industry and academia. We had two different languages, different interests, needs and expectations. A different game and a different reality" (Case A: PL8);
- "The culture was one of a private company, however, the company (bureaucracy) was more public than I expected" (Case C, PL17).

3. Interorganisational knowledge transfer

Interorganisational knowledge transfer implies the transfer of knowledge towards the private and public partners; the mother companies who financed and/ or initiated (or managed) the project organisations. Within case A, it was rather dependent on the mother companies what kind of knowledge they could receive. It was expected by the core group participants that the partners would have an active role in collecting knowledge. By the end of the case studies A and B, all final results were collected and published in a book that was presented to the mother companies. In case A, the mother companies had regular contact through the CEO and within annual meetings, but no clear results were demanded from the mother companies. From interviews with the industrial partners of case A, it became clear that several industrial partners perceived the project organisation as a bridge between industrial and commercial project organisations and research activities (Case A: SP1, SP8 and SP13)[2]. The industrial partners were asked if they were satisfied with case A, and they claimed that they were satisfied with subprojects 1, 4, 6 and 8 and dissatisfied with subproject 2. However, SP1 (of case A) mentioned that they presently have not planned to use the results in their own organisation, other than on special cases in order to learn. They state that in future studies, several experiences from the subprojects could be of value to their organisation.

> "One of the mother companies, made a product (a router) with help of the research material of one of the participants" (case A: PM10).

In case C, the mother companies produced a list of reports they want to receive once the project organisation delivers the final product. Furthermore, they receive quarterly reports from the project organisation.

Another aspect is that some mother companies have seconded expertise in the form of contact persons or experts to the internal core group (this happened in case A and C). These contact or expert persons brought a certain amount of knowledge from the mother organisation to the internal project organisation and vice versa.

4. Interpartner knowledge transfer

Besides the mother companies who financed the project organisations, there were several other companies involved (defined as service companies). The involvement of these companies was mainly in delivering expertise (in the form of people, i.e., PhD students or consultants) to the internal core group, in order to complete the project organisation goal. The participants of the project organisations were hired for a certain period of time, in order to fulfil a certain task (this could be development, research, implementation, management or control tasks). These participants gained experience and expertise of working within the project organisations and this personal knowledge was taken along once these participants left the project organisation. A large amount of the participants had a back-office or a private organisation to which they returned. These back-office organisations often had several ways of retrieving part of the knowledge that was gained in the project organisations, for example by seminars, documentation, publications, teaching and experience. On the other hand there were participants with no back-office, who were self-employed or who were seconded by temporary employment agencies. These members exploited the knowledge they learned in the project organisation in the form of consultant assignments or seminars towards other organisations. Some members of for example case C mentioned that they would leave the project organisation and would start their own company in order to sell the

[2] Case A: SP1 means, case study A, financial sponsor, number 1.

expertise they had gained in case study C. Furthermore, in Case A and B consultants worked who would exploit their learned knowledge to other assignments or to their back-office.

> "I do this work as an assignment for my own company that I just started. For my own company, I want to use the three years of this project, so that I also earn some money. I do not have other customers, but I am very interested in this project and hopefully I can make some new contacts for the future" (Case A: MP6).

Levels /Case study	**Case A**	**Case B**	**Case C**
Individual learning	• Content • Working in a VO • Social network	• Content • Working in a VO	• Content • Experience in project organisation • Political situation
Organisation knowledge transfer	• Some jargon • Expectations • Academic-industry gap	• -	• Routines/ quality procedures • Standards • Public-private gap
Inter-organisation knowledge transfer	• Future ideas • Book with results • Knowledge of own employees who worked within the project	• Book with results • Ideas • Confirmation of target	• Reports • Knowledge about the overall project development • Knowledge of own employees who worked within the project
Interpartner knowledge transfer	• Content • Social network • Knowledge of professionals	• Content • Ideas • Application • Knowledge of professionals	• Knowledge of professionals • Content • Experience • Social network
Interproject knowledge transfer Sequential Parallel	*Sequential (between A and B)* • Experience project management • Starting up VO • Finding partners/ funding • Networking • How to run a VO		*Parallel* • Experience • How to start up and run such a project • Content (innovative construction) • Project organisation structure • Knowledge management ideas

Table 9.6: Knowledge transfer and content of all three case studies A, B and C.

5. Interproject knowledge transfer

The last knowledge transfer level was found between different project organisations. Two forms were denoted. The first form is sequential interproject knowledge transfer, in which experience and knowledge of a project organisation is used into successor project organisations, after the disbandment of the project organisation. The second form is parallel interproject knowledge transfer, in which experience and knowledge are shared between project organisations who run parallel of each other and in which both project organisations can win of the knowledge sharing. Between case A and B,

sequential interproject knowledge transfer occurred. Case study B was a successor project organisation of case A, and the management (and the management of the initiating organisation behind both projects) of case A transferred knowledge about how to start up such a geographically dispersed project organisation into the second case study (B).

In case C, parallel interproject knowledge transfer was found, in which knowledge, experience and people were shared to a certain extent between two project organisations that performed similar tasks.

> "In case C and a similar project (D), people are exchanged for the super structure of the projects. The success of project D is dependent of project C and the success of project C is dependent on project D. Contractors of project D can learn a lot from project C. However, this is an attitude matter. The attitude of people has to change, so that they are interested in learning of other projects" (case C: PL18 & PL19).

Concluding one could state that for project organisations with a high degree of virtualness, transfer of organisational knowledge is difficult due to geographical dispersion, high fluctuation of the workforce, time limits and the use of IT for communication. Explicit knowledge can be more easily transferred over geographical space, however, it becomes difficult to transfer and develop tacit knowledge. For tacit knowledge, people have to be located close together, so that they can observe what others are performing.

9.5 Relation between virtualness and knowledge

The relationship between virtualness and knowledge transfer and development is partially discussed in the former section 9.4. A project organisation with a high degree of virtualness (complete dispersion and high use of IT), like case A, has more difficulty in transferring and developing project organisational knowledge than a project organisation whose members are closely located. The transfer of explicit knowledge could function rather well, through using IT for distribution of explicit knowledge. However, on the other hand, members should be willing to transfer this knowledge. Tacit knowledge is more difficult to transfer or develop organisationally in a virtual setting. From literature it becomes clear that transferring tacit knowledge can mainly be performed by neighbouring, observation and mentor-student relationships. A large amount of social interaction is needed for tacit knowledge transfer.

Case A had a rather high degree of virtualness. This high degree of virtualness had implications for knowledge development and transfer. However, there were several other aspects that played a role in this respect. The project organisation had an explorative task, in which research for a new electricity market was performed. Furthermore, the structure and design of the project organisation were new to the involved parties (including the management). There was hardly any hierarchy (although this appeared over time), responsibility structure and the final goal and the individual tasks were not clearly defined. These characteristics of the project organisation made interaction between its members important in order to discuss the development of the project organisation, the work performed and the final goal. However, the interactions between members were affected by the fact that there was no single location where people could meet. Meetings were held only once or twice a year, and members did not know each other in the beginning of the project organisation. The intention was that participants would integrate and communicate often with each other outside the formal meetings. However, little interdependency between the tasks (implying that there was

less need for interaction), the complete dispersion of the workforce and the fact that members did not know each other had impact on knowledge transfer and interaction in general. Furthermore, there were diverse expectations of all involvees present and these were not discussed or made explicit. The parties could see different benefits of the results of the project organisation. The mother companies required ideas for future products and markets, the PhD students received financial support to finish their dissertation, the supervisors received status and the consultants aimed for reputation and money. However, these different benefits were not made explicit and it was unclear for most core members what the financial sponsors wanted to gain from the project organisation. Another aspect of importance was the short amount of time (three years duration). Within this time several members ended their task or left the project organisation and new members joined the research. However, these new members were not introduced properly and had much difficulty to interact with the core group. Most work was performed individually; however, a small group of core members got more acquainted and tested several ways of communicating with help of IT. This small group had been part of the project organisation from the beginning and was committed to make communication and transfer of knowledge work. Knowledge development and transfer was difficult in case A. This difficulty had to do with the structure of the project organisation, the involvees, the time period and the way people communicated. However, a large part was due to the fact that the members were not located on a single place and could interact and communicate personally with each other. Members were not able to meet in person, get acquainted, and discuss research ideas or work together on an article. There was little time to build up trust between the involved parties of the project organisation.

Case B was a different project organisation and no organisational knowledge was developed. Some knowledge was transferred, but unclear was if the involved parties absorbed this knowledge. Case B had a complete dispersion, but hardly any use of IT for communication. Furthermore, case B did not aim at developing knowledge or at transferring knowledge within the core group. The project organisation was set up in such a way that participants could perform their individual task without intervention or dependency on the other members. The project leader would in the end integrate the different tasks and present them to the mother organisations. No routines were developed, but an information distribution structure was implemented from the beginning, based on the experience of the project leader. Due to the fact that there was no interdependency between the tasks, there was little need to communicate in between the meetings. Within the meetings, which were held five times (in one year), the individual work was summarised and the participants discussed how to present the work to the steering committee. Time was limited (only one year), and participants did not have the need or the opportunity to get acquainted. Due to the complete dispersion and little use of IT, members had much difficulty to contact each other and meet each other personally. The transfer of tacit knowledge was hardly performed within this project organisation.

Case C had a lower degree of virtualness than case A and B. Case C also had a number of characteristics that could have impact on knowledge development and transfer beside the lower degree of virtualness. Within case C, there were three locations for participants. Although there was geographical distance between these locations, within the locations, members could meet personally and could interact both formally and informally. For knowledge transfer and even development, it is important that people can meet each other personally and that they have the opportunity to work closely

together. The transfer tacit knowledge became more difficult between the three locations. The transfer of explicit knowledge and sometimes, tacit knowledge was affected positively by the fact that the tasks of participants were interdependent. People needed to interact and discuss matters in order to continue with their work. There was a need to co-operate in order to fulfil the requirements of the clients (mother organisations). For this reason procedures and a quality system were developed in order to gain a common understanding of the work processes and to have an unambiguous decision-making process.

Furthermore, procedures were developed for distributing information to each other. The project organisation lasts 10 years and within this time the project organisation had the ability to develop routines for processing information and procedures of how to deal with internal communication. Although the workforce fluctuated heavily (around 50% per year), all members were introduced on the intranet sites and interviews (placed on the intranet) were held in order to learn about the task and role of new participants. The project organisation was very large, and this required that it should be structured and co-ordinated in order to be able to steer and control the primary process within the stated time, budget and quality.

	Case A	**Case B**	**Case C**
Knowledge development and transfer	Individual Organisational (little) Interorganisational Interpartner Interproject	Individual Interpartner	Individual (experience) Organisational Interorganisational Interpartner Interproject
Virtualness	Negative impact on knowledge. Little transfer of tacit knowledge, more on explicit knowledge.	Negative impact on knowledge. Hardly any transfer of explicit and tacit knowledge.	Moderate impact. Virtualness gave communication problems; transfer of knowledge was affected partially.
Co-ordination	No structure, unclear responsibilities, tasks, roles (-). Freedom to steer the work, develop a structure (+)	No possibility for transferring or developing knowledge together (-)	Clear structure, hierarchy, and co-ordination (+). Differences in perspective between head office and regional offices (-)
Time	To little time to get acquainted and to learn (-)	To little time to get acquainted and to learn (-)	Much time to develop procedures, and get acquainted (+).
Involvees	Multi-disciplinarity (+/-) High fluctuation (-)	Multi-disciplinarity (+/-)	Multi-disciplinarity (+/-) High fluctuation (-)
Expectations	Not made explicit (-) Many conflicts (+/-)	Made explicit (+) Little conflicts (+/-)	Made explicit (+) Little conflicts (+/-)
Communication and information distribution	Personal communication preferred (+) Use of IT (+)	Personal communication preferred (+) Clear rules for distributing information (+)	Personal communication preferred (+) Clear rules for distributing information (+) Availability of Intranet (+)

Table 9.7: Relating virtualness to knowledge for all three case studies. (The - indicates a negative impact, the + indicates a positive impact on knowledge development and transfer, the +/- indicates that there can be both a negative and a positive impact of this item).

Within table 9.7 several aspects are mentioned which can be considered as positive and negative to knowledge development and transfer (-/+). These aspects are the multi-disciplinarity of involvees. On the one hand multi-disciplinarity is positive for developing knowledge, since members can gain new insights from different methodologies and different perspectives. However, on the other hand, members need time to explain and make explicit the differences and similarities within the disciplines in order to understand each other. In case A, it was clear that there was too little time to discuss this, and language problems and different perspectives had a more negative impact on sharing knowledge. Another aspect that is taken up is the expectation conflicts. This aspect is discussed more and related to literature in chapter 10. Expectation conflicts can be negative, since people do not perceive a match with their initial expectations and the current situation. However, expectation conflicts can be positive to learning, since a mismatch can make a person aware of unconscious expectations and it can increase the ability to reflect upon these expectations.

Knowledge transfer	**Case A**	**Case B**	**Case C**
Individual	High (New knowledge)	Medium (Applying to new situation)	Medium (Applying to new situation)
Organisation	Low to medium (Common jargon)	Low (None)	Medium (Procedures, norms)
Inter Organisation	Low (some transfer to 2 sponsors)	Low	Medium
Interpartner	Medium (Was still kept personal)	Low	Medium to high (Through seminars and assignments)
Interproject	Medium to high (Only from management)	Low	High (Both management and rotating personnel)
Type of knowledge transfer	Explicit Some tacit (in meetings)	Explicit	Explicit and tacit transfer (documents, meetings, mentor system).

Table 9.8: Knowledge transfer for all three case studies.

Table 9.8 presents the relation between the three cases and the knowledge transfer and development within the case studies. Case B had a moderate degree of virtualness with complete dispersion and no use of IT. Furthermore there was no interdependency or need to interact in between the meetings. The learning and knowledge transfer in this project organisation was low on all different levels (except for the individual level). Case C with a lower degree of virtualness presents a medium to, sometimes, high amount of knowledge transfer and learning of several levels, while case A with a high degree of virtualness shows little organisational knowledge transfer and development.

9.6 Conclusion

Concluding one could say that a high degree of virtualness is not very suitable for knowledge development and transfer on the project organisational level. Especially the transfer of tacit knowledge is complicated by the fact that members are geographically dispersed. It might be that in the future, IT is developed in such a way that people can communicate more easily to each other. Furthermore, in case A, the project organisation offered several applications for communication but due to a number of reasons these applications were only used by a small group of people. The reasons were (1) technical problems with the installation; (2) little training and an active role were

required of the members; (3) a generation gap, older members were less positive to use IT for communication than younger members were and (4) little time to develop trust. Besides the high degree of virtualness, the duration of the project organisation has implications for knowledge. A short duration is more negative for development of knowledge than a project organisation that lasts for 10 years. People need time to get acquainted, learn to trust each other and to develop some shared understanding in order to transfer and develop knowledge. This implies that project organisations should not be too short (less than 2 years of time) when the goal is to transfer and develop knowledge.

Within case C, members from the regional offices went to visit the construction sites in person, in order to see the progress of the work and to discuss if there were difficulties that concerned time, budget and quality. These members mentioned that they had to visit the construction site frequently in order to understand the construction work and to get acquainted with the members working there. Several members even stated that they had to develop and adjust the jargon in these discussions. For project organisations with a high degree of virtualness, it might be more suitable to co-operate when the project organisation is not too large. When the project organisation becomes very large, several ways for co-ordination and control are needed in order to see if the project organisation goals are fulfilled. For this co-ordination and control, interaction is important and this becomes more difficult when the workforce is completely dispersed and mainly communicates with IT.